2023 SEG grant application

Application for Small Equipment Grant (SEG)

The Small Equipment Grant program is funded with the generous support of the Vermont Technical Council, the VASE Board of Directors, and generous donors. Since their inception, over $100,000 in grant funds have been awarded to HOST (Hands On Science and Technology) and SEG recipients.

These grants are intended to enable Vermont teachers to incorporate opportunities for hands-on STEM activities **in their Vermont classrooms only.** VASE Small Equipment Grants are designed to make it easier for Vermont K-12 teachers to create new in-classroom activities to expose their students to the excitement of hands-on science and engineering experiences. The grants are designed to help offset the cost of the materials including hardware, software, lab equipment, STEM kits, maker tools, etc.

Project Title: *

Diving into RAM (Random Access Memory) - Creating Hands-on learning to explain transistor based computer memory circuits

Organization Name: *

Williston Central Schol

Primary Contact(s): *

Allan Miller

Affiliation
(i.e. school, ...)

Public School

Street Address: *

195 Central School Drive

City or Town (must be based in Vermont): *

Williston

Zip Code: *

05495

Website (optional):

EIN (Employer Identification Number):
Optional, if known-

Fed EIN # 89-3991100

Non-Profit status: *

- [x] Yes, non-profit
- [ ] No
- [ ] Other:

My organization has applied for a VASE SEG grant in the past *

- ( ) Yes
- (•) No
- ( ) Don't Know

If your organization received a past SEG grant, was a final report submitted? *

- ( ) Yes
- (•) No

NARRATIVE

Brief Summary of Proposed Project (please limit your response to no more than 5 sentences or 100 words)

Over the past two years, students in my Design Tech classes have been very successful creating and understanding simple electrical circuits as well as learning to code robots and microprocessors. However there is a huge learning gap between these two elements of computer science and that is understanding how to create an electrical circuit that can remember, calculate and be used to implement the complex processes that we are able to control with code. The project “Diving into RAM” will leverage the expertise of local retired Apple / Google engineer Larry Heyl to create a set of hands-on circuit board activities that can be used to explain this core concept - a learning experience that currently simply does not exist in any middle school friendly form (not even if you are willing to try to buy it) but is critical to true understanding of how a computer or microprocessor works. This $1250 grant will let us design, test, make and implement this teaching.

Funding amount requested: *
(projects can be funded up to $1,500)

1485

Description of and motivation for your program. Please include the following points in no more than 500 words: *
Describe in sufficient detail the program for which support is requested.
• Brief description of your group- what is its mission, approximate number of participants, grade level, age range and demographics of its members.
• Describe specific activities that the grant will support.

In my mind Design Tech is such a successful class due to two things - first it is almost completely hands-on and second it offers challenging content presenting in a way that is both interesting and relevant to things in their lives. My goal is summed up in a quote by T.S. Eliot in Four Quartets: "And the end of all our exploring will be to arrive where we started and know the place for the first time." When my lessons are completely successful, students are able to look at the technology around them - be it their computer or wooden toy - and have had experiences that let them see that thing differently. Suddenly they ponder "how does it work, who engineered it this way and why, could it be better, etc." We do this with electricity by exploring magnets, conductors, circuits, switches etc and suddenly something as simple as a dead battery raises thoughts of chemistry and physics. We do the same with coding - teaching the basics of how to control lights, buzzers and motors with a sequence of commands stored in a memory chip and as a result students start seeing how their entire lives are intertwined with coded machines: their watches, phones, dishwashers and of course computers. This is the core content curriculum of our 7th and 8th grade Design Tech classes, derived to align with the Next Generation Science Standards that they also explore (albeit from a different approach) in their science classes.

But it has a huge conceptual gap that currently I just gloss over with a few powerpoint slides talking about how computer memory is a few billion switches called transistors that store and calculate using the cumulative arithmetic of their on and off states. I make a quick reference to binary code - the huge collection of 0's and 1's that is the raw form of computer data - and then after showing where the micro-black box integrated circuit is located on their microbit jump beyond to get them coding. I don't try to fill the gap because up until now I've never had an hands-on method that can break down the concept of a circuit storing information and my 36 years of middle school teaching experience have taught me multiple times that didactic explanations of complex topics are not likely to have good outcomes in learning or behavior for 99% of students. (Translation - don't bore 7th and 8th graders!) This is not to say it isn't important - in fact I would argue it is perhaps the most significant understanding in order to truly grasp the amazing nature of modern computing - can a few billion on / off switches really be the brains behind an amazing Fortnite Battle Royale?

Serendipitously last spring WCS's ex-facility director Lyall Smith introduced me to Larry Heyl, a retired engineer who was helping organize a tree clearing project near the nature trail that borders the school. As we talked about what I teach in Design Tech, he excitedly shared his background designing the first powerbooks, iMacs, iPods, iPhones and iPads for Apple with Steve Jobs for over 30 years - many of which operate based on work he engineers and patented. As I explained this dilemma of not being able to create an effective / interesting lesson connecting circuits and coding, he quickly sketched out an idea for getting kids to build a 1 byte circuit board that clearly shows how a couple transistors in a creative circuit are all you need to have a "memory."

Six months and several prototypes later the lesson is ready to create. Larry's amazing connections give us access to a circuit board factory in Shenzen China that has created a boards that will be the basis of a two

or three day unit called “Diving into Ram” that let’s students dig into the core electrical principles of voltage, current and resistance through hands-on testing and then seeing the outcome of combining these with a simple compiler circuit that stores basic binary functions and can do simple arithmetic as well - all visualized with LED lights and switches. This grant will allow us to create the classroom set so that every student is hands-on with the lesson and have the tools to literally see how computer memory works. As this core concept exists in literally every coded electrical device - it has that potential to “arrive where we started and know the place for the first time.” That’s a whole lot more creative, innovative and effective than anything I can do with this concept!

Project Budget *

• Provide a budget, including proposed equipment or supply purchases, software, tools, travel, or other expenses for which support is requested, along with goals to be achieved through these resources. Describe other potential or confirmed funding sources with projected amounts. (If you would like to send a project budget by email as an attachment, be sure to include your project title, organization and contact name with the attachment to VTSCIENG@gmail.com)

The entire budget is for equipment: circuit boards, components, a few tools we do not have to do the final fabrication in the WCS Creation Studio, and student materials for the hands-on activities. My largest 7th / 8th grade class this year was 16, last year was 17 - so I have budgeted for materials for 18 which will leave a small buffer for any growth or damage without over purchasing. The soldering system is a bit expensive since in order to meet school safety requirements we need to have an active air filtration system in place in my classroom even though we do not plan to have students actually soldering except in small group after school situations where we may recruit a few highly motivated students to help with the component soldering since finalizing 140 circuit boards will take some work :-)

Circuit boards to be fabricated in Shenzen, China at the LFG Factory - cost is approximately $3 per board with shipping for the entire set approximately
80 Single Bit Memory boards
20 Simple LED single transistor board
40 Accumulator / Compiler board
$420
Components for 140 boards (transistors x 2), (resistors x 8), (switches x 2), (LEDs x 3)
$300
USB Power Supplies x 20
$120
Multimeters for voltage, resistance, amperage testing x 18
$270
Precision soldering set with certified air filtration system
$375
Total VASE Grant Request
$1485

Project Evaluation *

• I will submit a brief written final report summarizing project outcomes and future plans. In my report, I will document how funds were used.
Grant recipients may be invited to attend the Spring VASE membership meeting of scientists and engineers to give a presentation on the outcomes of their project. We also request grantee teams to prepare a brief (few minutes) creative YouTube video demonstrating their project and possibly the collaborative team work leading up to its fruition. (Note eligibility for future funding will be influenced by the submission of final reports with expenses, videos, and pictures.)

- [x] Yes
- [ ] No

What Success looks like-

1.To be successful, the activity must be primarily hands-on
2. Funds should directly support those doing the learning or making, not to classes, workshops, etc.
3. The activity should support the skills development and/or careers of the participants.
4. The activity should enhance collaboration among different organizations and/or age groups.
5. The activity should have a completion date within one year, and a plan to meet that date.
6. The activity should lead to a result which can be evaluated. Success should be measurable.
7. The organization should use the funds wisely and document how the funds are used.

8. Is
your project aligned with VT science standards?

NOTE :
VASE Small Equipment grants are designed to cover **in-classroom experiences only** and are not intended to cover extracurricular activities such as robotic clubs. For those programs please see VASE HOST grants information at *https://www.vtscieng.org/host-grants*

This is definitely an in-class project

Typed Signature of Applicant with applicant's role for the project *

Allan Miller - Project Leader